Unapproved Minutes of Fall 2021 TF PCS IEEE PC57.136, "Guide for Audible Sound of Liquid-Immersed Power Transformers"

The task force met at 12:55 PM, on Monday, November 15, 2021 as part of the TF PCS Audible Sound Revision to Clause 13 of C57.12.90 meeting. Chairman Steve Antosz presided over the meeting with Ramsis Girgis being the Vice-Chair, and Mats Bernesjo as Secretary.

The total membership of the WG is 47, including 22 requested membership at this meeting. The total attendance was 51.

First, the Chairman gave the following background for the new Guide:

- C57.136 was the "Sound Abatement Guide" and the document expired several years ago
- 2019/2020 was decided to resurrect/update it
- The PAR was approved in early 2021
- An early draft was circulated to TF participants in April 2021
- Some feedback was received and incorporated
- The draft was updated Summer/Fall 2021

The new guide has made significant progress and noise experts are asked to review the latest draft and provide more material where needed. The following list of technical chapters and sections of the Guide are summarized below:

Chapter 3 Basics and Standards of Transformer Noise

3.2 Sources and characteristics of transformer noise
3.2.1 Core noise
3.2.1.1 Impact of Core design & material
3.2.1.2 Frequency spectrum
3.2.1.3 Impact of Core and Tank resonances
3.2.1.4 Impact of Tap Changer position
3.2.1.5 Impact of load and load power factor
3.2.1.6 Impact of core temperature
3.2.2 Load noise
3.2.2.1 Sources of load noise
3.2.2.2 Design factors impacting load noise level
3.2.2.3 Impact of load
3.2.2.4 Frequency components
3.2.2.5 Impact of tap changer position
3.2.2.6 Impact of temperature
3.2.3 Cooling system noise
3.2.4 Contribution of components of transformer noise to the total noise level of transformers
3.3 Transformer industry standards related to noise
3.3.1 IEEE Standards
3.3.2 IEC Standards
3.3.3 Sound level information used in the IEEE & IEC Standards

Chapter 4 Factors affecting sound levels in field operation

4.1 Operating voltage and tap-changer settings
4.2 Noise of auxiliary transformers and reactors
4.3 Load noise
4.4 Load power factor
4.5 Voltage and load current harmonics
4.5.1 Load current harmonics
4.5.2 Harmonics in the excitation voltage

4.6 DC and GIC current
4.7 Contribution from vibrations of structures attached to the transformer
4.8 Contribution of sound build-up from surrounding sound / fire walls
4.9 Impact of transformer mounting
4.10 Other sources of noise on site
4.11 Operating temperature

Chapter 5 Transformer noise reduction in the design stage and factory

5.1 Methods to reduce core noise
5.1.1 Lower core flux density
5.1.2 Usage of high permeability grain-oriented core steel
5.1.3 Avoiding core resonance
5.1.4 Filling tank stiffeners with sand
5.1.5 Other means
5.2 Methods to reduce / eliminate cooling equipment noise
5.3 Methods to reduce load noise
5.4 Methods to reduce both core and load noise
5.4.1 Low noise tank design
5.4.2 Vibration isolation between active part and tank
5.4.3 Tank mounted external sound panels
5.4.4 Sound enclosures
5.5 Older methods of transformer noise reduction

Chapter 6 Methods to reduce noise on site

6.1 Sound enclosures
6.2 Sound barriers and walls
6.3 Other field installed techniques

Chapter 7 Determination of required sound levels of power transformers on-site

7.1 Simplified relationship between sound level of a transformer and sound level at specific receiver locations on the far field
7.2 Determination of appropriate noise level of a transformer on site

It was reported that input into Clauses 6.1 and 6.2 was solicited from Sanjay Patel and is expected to be received in the next week or two. Also, material of Clause 7.2 was requested from Chris Howell of Burns & McDonnel and was recently received. These will be added in the next draft of the Guide.

In relation to clause 7.2 regarding methods of determination of appropriate noise level of a transformer on site, one manufacturer noted that some specifications from the north-east region of the country specify the same low total noise level for transformers of a wide range of MVA ratings. This represents added expense to the customer to try to achieve such low noise levels for larger transformers. Several utility representatives commented on how they determine sound requirements for their transformer Specifications. The Vice Chair commented that he previously gave a presentation at a tutorial (Fall 2020 meeting) specifically on issues with some sound requirements in Specification. He promised to add this presentation to the website of the IEEE Standards.

A solicitation of those in attendance was initiated to request membership in the Noise Guide. A total of twenty-two requests were received. The following names are included in this following table.

Scott Digby	Hugo Flores	Ajith Varghese	Vinay Mehrotra	David Wallach
Chris Slattery	Klaus Pointer	Marc Taylor	Sanjib Som	William Boettger
John K. John	Eduardo Garcia	Enrique Betancourt	Elise Arnold	Markus Schiessl
Steve Brzoznowski	Kurt Kaineder	Everton De Oliveira	K. Vijayan	Thomas Hartmann
Kiran Vendante	Kayland Adams			

Finally, a request was made to members of the newly formed Guide WG to review the next draft of the Noise Guide and provide feedback, add text, as well as add their experience to Chapter 6 on methods on noise mitigation on site. The current Draft will be posted on the committee website in the C57.136 section under Performance Characteristics Sub Committee and it will be posted again after updates are made.

With no new business raised, the meeting was adjourned.

Respectfully submitted,
Mats Bernesjo, WG Secretary

Fall 2021 WG Meeting Attendance and Affiliation is as follows:

First Name	Last Name	Company
Stephen	Antosz	Stephen Antosz & Associates, Inc
Ramsis	Girgis	Hitachi Energy
Mats	Bernesjo	Hitachi Energy
Kayland	Adams	SPX Transformer Solutions, Inc.
Stephen	Anthony	--
Elise	Arnold	SGB
Suresh	Babanna	SPX Transformer Solutions, Inc.
Peter	Balma	Retired
Enrique	Betancourt	Prolec GE
William	Boettger	Boettger Transformer Consulting LLC
Joshua	Bohrn	PacifiCorp
Bruno	Bosnjak	Hyundai Electric Switzerland
Steven	Brzoznowski	Bonneville Power Administration
John	Crouse	Roswell Alliance
Everton	De Oliveira	Siemens Energy
Scott	Dennis	Hitachi Energy
Scott	Digby	Duke Energy
Hugo	Flores	Hitachi Energy
Raymond	Frazier	Ameren
Eduardo	Garcia Wild	Siemens Energy
Ismail	Guner	Hydro-Quebec
Thomas	Hartmann	Pepco Holdings Inc.
Nicholas	Jensen	Delta Star Inc.
John	John	Virginia Transformer Corp.
Akash	Joshi	Black & Veatch
Kurt	Kaineder	Siemens Energy
Zan	Kiparizoski	Howard Industries
Vinay	Mehrotra	SPX Transformer Solutions, Inc.
Nitesh	Patel	Hyundai Power Transformers USA
Sanjay	Patel	Smit Transformer
Brian	Penny	Retired
Klaus	Pointner	Trench Austria GmbH
Bertrand	Poulin	Hitachi Energy
Hakan	Sahin	Virginia/Georgia Transformer
Dinesh	Sankarakurup	Duke Energy
Daniel	Sauer	EATON Corporation
Markus	Schiessl	SGB
Cihangir	Sen	Duke Energy
Christopher	Slattery	FirstEnergy Corp.
Sanjib	Som	Pennsylvania Transformer
Marc	Taylor	JFE Shoji Power Canada Inc.
Ajith	Varghese	SPX Transformer Solutions, Inc.

First Name	Last Name	Company
Jason	Varnell	Doble Engineering Co.
Kiran	Vedante	Ritz Instrument Transformers
Krishnamurthy	Vijayan	PTI Transformers
Dharam	Vir	SPX Transformer Solutions, Inc.
David	Wallach	Duke Energy
Onome	Avanoma	MJ Consulting
Barry	Beaster	H-J Family of Companies
Afshin	Rezaei-Zare	York University
Rogerio	Verdolin	Verdolin Solutions Inc.